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LANDSAT'S ROLE IN  
STATE COASTAL MANAGEMENT PROGRAMS

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LANDSAT'S ROLE IN  
STATE COASTAL MANAGEMENT PROGRAMS

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## OBJECTIVE OF THE REPORT

Landsat-derived remote sensing data has potential utility for programs initiated by states to meet national goals for surface mining control and reclamation. Typical of legislation requiring planning and management of natural resources to achieve its specific objectives, this act relies primarily on state action. States are required to develop land use plans to assure as far as practicable that proposed activities affecting coastal zones do not contradict reasoned alternative land use decisions and basic environmental integrity.

Intergovernmental, cooperative effort is necessary to achieve the national goals established for coastal zone management. The Act designates the National Oceanic and Atmospheric Administration, Department of Commerce, as the cognizant agency to approve state programs and grant monies for implementation. The States respond to the Act's mandates by developing programs and creating management capabilities to more effectively oversee utilization of coastal areas.

Land use planning is an integral part of state programs responding to the Coastal Zone Management Act. Landsat remote sensing can be one tool in developing plans, guiding implementation and monitoring results. State experiences suggest this potential for both the Federal Program Officer responsible for overseeing the grant program and the state operating agency personnel responsible for planning and implementation.

This report provides both the framework for state programs found in the Act and examples of state opportunities to use Landsat. Present activities suggest that Landsat remote sensing can be an efficient, effective tool for coastal zone management. New capabilities are being developed. Interaction with cognizant federal, state and local personnel involved in these activities can guide these activities and enhance their utility and prospect for use.

## FEDERAL LEGISLATION

### Federal Perspective

Federal legislation speaks to the goals of the Nation. Fulfillment of these goals often requires the cooperative spirit of federalism embodied in specific program mandates for non Federal governments, most often States, to implement with guidelines and financial assistance derived from the original legislative legislation.

The Coastal Zone Management Act of 1972 (with Amendments of 1976) recognizes the national interest in effective management, beneficial use, protection, and development of the coastal zone. The potential for competing demands is clearly recognized in Sec. 302(c) to include requirements for industry, commerce, residential development, recreation, extraction of mineral resources and fossil fuels, transportation and navigation, waste disposal, and harvesting of fish, shellfish, and other living marine resources. There is also the competing need for coastal area allowed to remain in a natural state.

The important role of the States is stated in Sec. 302(h).

The key to more effective protection and use of the land and water resources of the coastal zone is to encourage the states to exercise their full authority over the lands and waters in the coastal zone by assisting the states, in cooperation with Federal and local governments and other vitally affected interests, in developing land and water use programs for the coastal zone, including unified policies, criteria, standards, methods, and processes for dealing with land and water use decisions of more than local significance.

The Declaration of Policy, Section 303, highlights the basic elements of the national plan for action.

Section 303. The Congress finds and declares that it is the national policy (a) to preserve, protect, develop, and where possible, to restore or enhance, the resources of the Nation's coastal zone for this and succeeding generations, (b) to encourage and assist the states to exercise effectively their responsibilities in the coastal zone through the development and implementation of management programs to achieve wise use of the land and water resources of the coastal zone giving full consideration to ecological, cultural, historic, and esthetic values as well as to needs for economic development, (c) for all Federal agencies engaged in programs affecting the coastal zone to cooperate and participate with state and local governments and regional agencies in effectuating the purposes of this title, and (d) to encourage the participation of the public, of Federal, state, and local governments and of regional agencies in the development of coastal zone management programs. With respect to implementation of such management programs, it is the national policy to encourage cooperation among the various state and regional agencies, including

establishment of interstate and regional agreements, cooperative procedures, and joint action particularly regarding environmental programs.

The states are the fiscal point for action. To assist states in fulfilling their responsibilities for effective coastal zone management, grants are made available to develop and implement management programs. The Coastal Zone Management Act establishes the criteria for grant funding which include activities basic to effective planning for natural resources utilization.

## MANAGEMENT PROGRAM DEVELOPMENT GRANTS

Sec. 305. (a) The Secretary may make grants to any coastal state--

(1) under subsection (c) for the purpose of assisting such state in the development of a management program for the land and water resources of its coastal zone; and

(2) under subsection (d) for the purpose of assisting such state in the completion of the development, and the initial implementation, of its management program before such state qualifies for administrative grants under section 306.

(b) The management program for each coastal state shall include each of the following requirements:

(1) An identification of the boundaries of the coastal zone subject to the management program.

(2) A definition of what shall constitute permissible land uses and water uses within the coastal zone which have a direct and significant impact on the coastal waters.

(3) An inventory and designation of areas of particular concern within the coastal zone.

(4) An identification of the means by which the state proposes to exert control over the land uses and water uses referred to in paragraph (2), including a listing of relevant constitutional provisions, laws, regulations, and judicial decisions.

(5) Broad guidelines on priorities of uses in particular areas, including specifically those uses of lowest priority.

(6) A description of the organization structure proposed to implement such management program, including the responsibilities and inter-relationships of local, areawide, state, regional, and interstate agencies in the management process.

(7) A definition of the term "beach" and a planning process for the protection of, and access to, public beaches and other public coastal areas of environmental, recreational, historical, esthetic, ecological, or cultural value.

(8) A planning process for energy facilities likely to be located in, or which may significantly affect, the coastal zone, including, but not limited to, a process for anticipating and managing the impacts from such facilities.

(9) A planning process for (A) assessing the effects of shoreline erosion (however caused), and (B) studying and evaluating ways to control, or lessen the impact of, such erosion, and to restore areas adversely affected by such erosion.

(c) The Secretary may make a grant annually to any coastal state for the purposes described in subsection (a)(1) if such state reasonably demonstrates to the satisfaction of the Secretary that such grant will be used to develop a management program consistent with the requirements set forth in section 306. The amount of any such grant shall not exceed 80 per centum of such state's costs for such purposes in any one year. No coastal state is eligible to receive more than four grants pursuant to this subsection. After the initial grant is made to any coastal state pursuant to this subsection, no subsequent grant shall be made to such state pursuant to this subsection unless the Secretary finds that such state is satisfactorily developing its management program. . . .

(g) With the approval of the Secretary, any coastal state may allocate to any local government, to any areawide agency designated under section 204 of the Demonstration Cities and Metropolitan Development Act of 1966, to any regional agency, or to any interstate agency, a portion of any grant received by it under this section for the purpose of carrying out the provision of this section.

#### ADMINISTRATIVE GRANTS

##### Sec. 306

(a) The Secretary may make a grant annually to any coastal state for not more than 80 per centum of the costs of administering such state's management program if the Secretary (1) finds that such program meets the requirements of section 305(b), and (2) approves such program in accordance with subsections (c), (d), and (e)....

(e) Prior to granting approval, the Secretary shall also find that the program provides:

(1) for any one or a combination of the following general techniques for control of land and water uses within the coastal zone;

(A) State establishment of criteria and standards for local implementation, subject to administrative review and enforcement of compliance;

(B) Direct state land and water use planning and regulation; or

(C) State administrative review for consistency with the management program of all development plans, projects, or land and water use regulations, including exceptions and variances thereto, proposed by any state or local authority or private developer, with power to approve or disapprove after public notice and an opportunity for hearings.

(2) for a method of assuring that local land and water use regulations within the coastal zone do not unreasonably restrict or exclude land and water uses of regional benefit.



## A SAMPLING OF STATE EXPERIENCE

### Opportunities for Landsat Use

P.L. 92-583, the Federal Coastal Zone Management Act of 1972, has as an important goal that coastal management should "preserve, protect, develop and where possible restore and enhance the resources of the Nation's coastal zone for this and succeeding generations." The dual goal of protection and development requires the states to develop the policies, legal authority and institutional arrangements to resolve conflicts and coordinate among many levels of government. Unlike some other federal grant programs designed to help states develop capacities to manage specific environmental concerns without regard to geographic location--i.e., clean water, and coal mining and reclamation, the federal CZMA is general in scope and quite comprehensive for a single geographic region. The entire state's "coastal zone" must be addressed by the state program along federal guidelines established and administered by NOAA, Office of Coastal Zone Management (OCZM).

The CZMA and later Amendments actually created several different grant programs available to states. The two most important have been Section 305, Program Development Grants, and Section 306, Program Administration Grants. In 1979, over \$4.5 billion were available to states eligible for the last year of 305 funding, and \$18 billion to states eligible for 306 funding. Other grant programs authorized under CZMA--and the amount funded in 1979, include Estuaries Sanctuary Grants (section 312)--\$3 billion, and Marine Sanctuary--\$500 million. A related grant program administered by OCZM is the Coastal Energy Impact Program (CEIP) related to Outer Continental Shelf (OCS) petroleum development with Energy Impact Formula Grants funded at almost \$28 billion in 1979.

States that examined Landsat data as a means to support coastal management for regional, repetitive data requirements, first did so during the "305" program development phase between 1974 and 1979. During that time state programs were distracted with attempting to cope with the difficult tasks of providing opportunities for public participation, creating a constituency, analyzing existing institutional arrangements, proposing new ones, and addressing new legislation in order to comply with federal law. Data gathering efforts during this phase were mostly compilations of existing data and information needed to identify what needed to be done.

Coastal Atlases were prepared in small scale, regional formats by almost every coastal state. Texas, Florida and Minnesota, for example, prepared detailed colored publications for general distribution and use. Some new data-gathering efforts were also initiated to provide needed "base-line" information--data of essentially one "vintage," collected with standard methods, and displayed in a consistent and compatible format throughout. Many states, including Florida, Texas and New Jersey, used CZMA funds to acquire Coastal aerial photography as base-line data.

Several states also identified the need to develop "planning methods," or other systematic analytical procedures or models for evaluating and resolving conflicts between development and preservation. For example, New Jersey developed and incorporated the Coastal Location Acceptability Method or CLAM as an integral part of its program. While in Texas, a similar, but more elaborate Activity Assessment Routine (AAR) was developed, but not implemented, because reviewers felt it needed further testing and lacked adequate supporting data.

For the most part, state coastal management programs recognized the need to have adequate data and information, but also were largely preoccupied with the "politics" of developing mechanisms for coordination and conflict resolution. One might say that there have been few, if any, "operational" uses of Landsat by State coastal management programs where the program itself was not yet "operational." However, such a statement is selling both the technology and the states short.

Coastal states have designed Landsat studies in cooperation with NASA to inventory current land cover and land use including wetlands, to determine shoreline lengths and shoreline changes, to study near shore water circulation and colors, and to monitor the tidal inundation history of shorelines and wetland areas in repetitive Landsat scenes. Some of these applications have been continued, while other were set aside until the program development phase was completed and the appropriate use could be determined.

At least one of the survey states cited in this report--New Jersey--is now "operational," having an approved "306" program for three-fourths of its coastal areas--the Bay and Ocean Shore Segment or BOSS. And New Jersey is actively working to expand their capability to use Landsat. Others are still working to bring their proposed programs into line with federal guidelines; sometimes at great odds to traditional political trends. Some states recently have even chosen not to participate, relying instead on existing state authority and procedures. But regardless of whether the states successfully participate in the federal program or not, some of the lessons they have learned from using Landsat data--the innovations and ideas--could have great impact on lowering future program costs, while maintaining program performance for state and/or federal coastal management responsibilities.

## New Jersey

### Summary of State Program

The document outlining the state program, the New Jersey Coastal Management Program - Bay and Ocean Shore Segment (BOSS), was prepared to determine and describe New Jersey's strategy to manage the future protection and development of the coast. New Jersey is preparing its coastal management program in two phases. The geographic area addressed by the first part of the New Jersey Coastal Management Program includes a 1,382 square mile land area and related coastal waters in a region stretching from the Raritan Bay along the Atlantic ocean front to the Delaware Bay. This is the area defined by the State Legislature in the Coastal Area Facility Review Act (CAFRA) of 1973, plus tidal wetland areas inland of the CAFRA boundary which are regulated under the Wetlands Act of 1970. The second phase still under development covers the riverine, and most urbanized part of the state.

The New Jersey CMP includes Coastal Resource and Development Policies and the management system used by the Department of Environmental Protection and the Department of Energy in managing activities in this coastal program segment. The Coastal Policies are divided into three groups: (1) Location Policies evaluate specific types of coastal locations, such as wetlands and prime farm land; (2) Use Policies are directed at different uses of the coastal zone, such as housing and energy facility development; and (3) Resource Policies focus on controlling the effects of development, such as water runoff and soil erosion.

The major choices and basic direction in the many specific policy statements are represented by four Basic Coastal Policies:

1. Protect the coastal ecosystem.
2. Concentrate rather than disperse the pattern of coastal residential, commercial, industrial, and resort-oriented development, and encourage the preservation of open space.
3. Employ a method for decision-making which allows each coastal location to be evaluated in terms of both the advantages and the disadvantages it offers for development.
4. Protect the health, safety and welfare of people who reside, work, and visit in the coastal zone.

The Coastal Program is implemented through existing state laws and agencies. The principal legal authority will be the coordinated use of the Coastal Areas Facility Review Act (CAFRA), Wetlands and waterfront development (riparian) programs, shore protection program and the regulatory activities of the Department of Energy.

The Coastal Area Facility Review Act (N.J.S.A. 13:19-1 et seq.) is New Jersey's major coastal law. In CAFRA, the Legislature entrusted the Department of Environmental Protection with the responsibility to regulate the

location, design and construction of housing developments and most major industrial, sewer, and energy facilities in the legislatively-defined "Coastal Area."

DEP also has authority to regulate certain activities on mapped coastal wetlands, under the Wetlands Act of 1970 (N.J.S.A. 12:9A-1 et seq.). Virtually any development in a mapped tidal wetland must receive a Wetlands permit before construction can begin. In addition, certain activities are prohibited in the wetlands, including dumping solid waste, discharging treated or untreated sewage waste, storing or disposing of pesticides, applying persistent pesticides, and applying pesticides on significant stands of wetlands vegetation.

New Jersey's third major coastal law is the set of riparian statutes which apply to the lands now or formerly overflowed by tidal waters. Under these statutes DEP and the Natural Resource Council (an autonomous but closely related citizen body, with members appointed by the Governor with the consent of the State Senate) can sell or lease these lands, and manage most activities on the lands through the administration of the Waterfront Development permit program. Through the riparian statutes, DEP requires a permit for construction or alteration of facilities such as a dock, wharf, pier, bulkhead, bridge, pipeline or cable, and dredging and filling involving lands flowed by the tide.

New Jersey developed a regional planning method, the Coastal Location Acceptability Method (CLAM), to guide permit applicants when preparing applications and to assist DEP staff in evaluating permit applications. The purpose of the method was to detail a framework that could (1) combine information about the resources and processes of the natural and social environment and human values, (2) predict the implications of alternative locations of land and water use and (3) evaluate proposed activities against a coherent set of policies.

The Coastal Program was also designed to take advantage of the consistency provisions with respect to federal actions and actions of other agencies to carry out the Basic Coastal Policies, to the extent statutorily permissible. Finally, the Coastal Program will serve in a guidance capacity to municipal, county and regional agencies with coastal decision-making responsibilities.

## Rationale for Use of Landsat

A key deficiency in New Jersey, identified by the state coastal management program, was the lack of accurate, up-to-date data on land and water surface conditions. The best surface information included USGS topographic maps, aerial photographs collected for a number of different programs, and vegetation survey maps. The USGS maps were all below national map accuracy standards and up to twenty years out of date. The photo data was variable in date, scale and resolution, as well as being difficult and expensive to interpret; and the vegetation information was generalized and had been interpreted from ten-year old photographs.

This fragmented, out-of-date, non-compatible and cumbersome data base--viewed as quite typical of existing state geographical information--led the state to identify the need for new surveys and better techniques of monitoring, updating, and managing the information needed. However, with limited funds for new data, and the large areas to be surveyed, traditional, air photo/ground survey mapping techniques cannot be afforded very often. The New Jersey Coastal Management Program concluded that Landsat was a possible solution for supplying repetitive, low-cost, regional information. The coastal program had done some preliminary work with Landsat soon after the first satellite was launched in 1972 in cooperation with a private firm. However, it was not until the state coastal program matured and the NASA Eastern Regional Remote Sensing Center (ERRSAC) made contact with the State of New Jersey that serious efforts began to incorporate Landsat capabilities into the State program.

## The Landsat Experience

New Jersey's coastal program had been testing new techniques of data collection and analysis in a pilot area in Cape May County, the southern peninsula of the State related to the Coastal Location Accessibility Method (CLAM). New Jersey used the same study area for a demonstration in cooperation with NASA. Landsat data of the county collected in June 1978, was used to test the spectral and spatial resolution of the data relative to producing a surface cover map suitable for coastal management.

The coastal ecotone was found to present special problems for Landsat classification because so many features are narrow and linear. Beaches, dunes, tidal guts, streams and floodplains all tend to approach the limits of Landsat resolution. Even so, it was possible to identify areas of high and low vigor forms of *Spartina alterniflora*, the critical wetland species of estuarine primary productivity. Areas containing *Spartina patens*, *Phragmites* and other wetland species also had clearly distinct signatures. The resolution of swamp and upland forests, including the highly valued Atlantic white cedar and the federally protected oak-pine and pine-oak forests of the New Jersey Pine Barrens, was equally impressive. Agricultural signatures, however, showed such bewildering variety that they were set aside for further work.

And the least satisfactory results were obtained for the urban categories. The land cover map generated had thirty classes and was considered to have more detail than existing maps and to be quite adequate for regional coastal planning purposes.

Because of the indifferent quality of source data and the extreme difficulty of doing the complicated manual map overlays required, the application of the CLAM planning method is at present limited far below its potential. A simplified version of CLAM is now being used in three coastal permit programs and the method is standing up to appeals. However, it is recognized that the next steps must be computerized. Consequently, the New Jersey Coastal Management Program is presently digitizing a number of maps of Cape May County including soils, topography transport systems and property boundaries to be included in an automated geographic information system.

New Jersey is making a joint proposal with the Council on Environmental Quality to the National Science Foundation for the development of relational data base management and graphics software to allow user-interactive map overlay analysis. If this system can be created, the inclusion of the data interpreted from Landsat is comparatively simple. Landsat is anticipated to provide current, regional data to support over half the analysis factors.

## Texas

### Summary of State Program

The State of Texas completed the "305" program development phase and submitted the proposed Texas Coastal Program to the Office of Coastal Zone Management in June 1979. The Texas Coastal Program retains the current permitting requirements and jurisdictions of all state agencies. The proposed Program utilizes existing standards and guidelines which are used by agencies to determine whether a proposed project is acceptable. The Program will seek to improve the coastal management process without developing a new regulatory program. Instead, the Texas Program will network the existing state institutional framework, policies and performance standards. The only additional requirement will be that Federal permit and license applicants--if the Texas program ultimately receives final approval under Section 306 of the Federal Coastal Zone Management Act--must obtain certification from the Texas Energy and Natural Resources Advisory Council (composed of the relevant State Agency heads and chaired by the Governor) or that a project located within the coastal boundary is consistent with the State's program.

The Texas Coastal Program boundary is coextensive with that of the first tier of coastal counties to provide easy administration and to maximize the number of communities which can qualify for Federal Coastal Energy Impact Program funds. There will be no new regulatory program within the boundary. Instead, the coastal area boundary will provide focus for the state's coastal planning and coordination activities, and emphasize the coastal policies that agencies already must follow in their regulatory and other functions under existing law. The boundary also puts the federal government on notice of where its actions must be consistent with Texas coastal policies.

During the remaining part of the Section 305(d) program development stage of the Texas Coastal Program, the State of Texas will continue to improve its existing management capabilities. The first priority will be to develop a memorandum of understanding containing guidelines and performance standards for evaluating activities proposed for tidewater wetlands. These standards will be established by agreement among the Texas Energy and Natural Resources Advisory Council or its successor, the Texas Department of Water Resources, the Texas Parks and Wildlife Department, the Federal Land Office, the Texas Railroad Commission, the U.S. Army Corps of Engineers, the U.S. Fish & Wildlife Service, the National Marine Fisheries Service, and the Environmental Protection Agency. These standards will enable permit applicants for Corps section 404 Federal Clean Water Act and section 10 permits under the 1899 Rivers and Harbors Act to predict whether a proposed activity will or will not be permitted and what types of special permit conditions are likely to be imposed. These standards will be applied by the Department of Water Resources and the Texas Railroad Commission in granting certifications under section 401 of the Federal Clean Water Act and by the Coastal Zone Management Act. This will lend certainty to the permitting process

and will inform permit applicants and federal agencies what activities and impacts will be considered consistent with the Texas Coastal Management Program.

If the federal government through the Corps of Engineers delegates the dredged materials disposal responsibility to the State of Texas, the State will develop necessary implementation guidelines through the Department of Water Resources, the Texas Railroad Commission, the General Land Office, and the Texas Parks and Wildlife Department. Finally, the State will work for simplification of the permitting process by developing a single permit application form for permits from the U.S. Army Corps of Engineers, the Texas Parks and Wildlife Department, the General Land Office, the Railroad Commission, and the Texas Department of Water Resources.

Additional priorities identified for program development include the State's identification of critical coastal wetlands with an eye toward eventual acquisition. Another important effort will be designation by the General Land Office of critical dune areas for county protection. The State will continue to manage the numerous submerged State lands and emergent lands important to recreation, fisheries, and wildlife which are located in State parks and State wildlife management areas. The Texas Antiquities Committee will continue its work locating archaeological, cultural, and historic resources, including historic shipwrecks in Texas bays. By conducting habitat evaluations, areas which would be suitable for placement of dredged materials within the Texas coastal zone will be identified. The Texas Parks and Wildlife Department has proposed numerous surveys and studies to enhance its fisheries management capabilities.

The State of Texas has prepared the program document to describe what Texas has done to develop means to manage its coast, the current state of that management program, and the ongoing management activities of the State agencies. The final document describes in a comprehensive manner the many policies and programs which are implemented by the agencies responsible for coastal management in Texas. More importantly, however, it establishes a work plan under which Texas can coordinate and improve these activities so that Texas can achieve a coherent, comprehensive coastal program.



## Rationale for Use of Landsat

In November 1973, during preparation of the Texas Remote Sensing Plan, to address the remote sensing information needs of state agencies, the state decided to participate in the Second Earth Resources Satellite (ERTS-B) research program funded through NASA, Goddard Space Flight Center. The Remote Sensing Task Force decided that this program would be a complementary step in formulating the Texas Remote Sensing Plan, and because of recent state and federal legislation concerning coastal zone management that involved the General Land Office (GLO), requested that the GLO prepare a proposal for submission to NASA. The Texas Natural Resources Information System, the Texas Parks and Wildlife Department, and the Bureau of Economic Geology also participated in the resulting Landsat investigation.

The Texas coastal zone is about 370 miles long and the first tier of counties extends inland about 40-50 miles. Of this area of about 15,000 square miles or nearly 10 million acres, over 4 million acres are submerged lands owned by the State of Texas and administered by the General Land Office. The Coastal Public Lands Management Act of 1973 directed the School Land Board with the assistance of Texas General Land Office (GLO) staff to draft and implement a comprehensive management program for these state-owned lands, as well as to undertake the following:

- (1) A continuous inventory of coastal lands and water resources...;
- (2) A continuous analysis of the potential uses to which the coastal public lands and waters might be put, including recommendations as to which configurations of uses consonant with the policies of this Act maximize the benefits conferred upon the present and future citizens of Texas;
- (3) Guidelines on the priority of uses in coastal public lands within the coastal area; including specifically those uses of lowest priority;
- (4) A definition of the permissible uses of the coastal public lands and waters and definitions of the uses of adjacent areas which would have a significant adverse impact upon the management or use of coastal public lands or waters...

(The General Land Office and Texas Coastal Marine Council, 1974, and TEX.REV.CIV.STAT.ANN. art.541e-1, Supp. 1976).

These "operational" responsibilities along with the 305 program development activities of which the GLO was a part, and specifically the need to acquire cost-effective techniques for the continuous inventory of coastal land and water resources within such a large coastal zone, provided the rationale for Texas investigating Landsat as a data source to support coastal management.

## The Landsat Experience

As a result of the original Landsat investigation, the following observations were made about uses of Landsat in support of coastal management activities:

- (1) A library of Landsat scenes would be extremely useful to supplement information gathered from visual observations and tide gage data regarding the areal extent of inundation are not now available for bay shorelines in Texas, they could be used to extend tide gage measurements for determining legal boundaries and to estimate shoreline boundary locations for management purposes without additional ground surveys.
- (2) Monitoring spoil areas is an important use of Landsat because navigation channels in Texas bays require continuous dredging, and adjacent state-owned submerged lands and wetlands are used as spoil disposal sites, unless areas containing wetland vegetation are located and thus can be avoided.
- (3) Development of a land cover and land use classification system and mapping methodology for the Texas coast supported by Landsat data, also could satisfy part of the requirement for a "continuous inventory" by updating existing land use and land cover information from aerial photography.

Experience gained by the Texas Natural Resources Information System (TNRIS)\* agencies and TNRI Systems Central staff over the past several years led to development of a capability for utilizing Landsat data to support some coastal management operational requirements. Efforts have also been made to evaluate other potential applications of Landsat data within the state.

However, it also became obvious to the Landsat data users that considerable improvement was needed in the existing capabilities if maximum value at minimum cost were to be achieved. For one thing, Landsat data appears to be of most value when used in conjunction with data from other sources, including various types and scales of aircraft imagery and appropriate geographic

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\* The Texas Natural Resources Information System (TNRIS) is being implemented through the TNRIS Task Force of the Texas Energy and Natural Resources Advisory Council (TENRAC). The TENRAC membership includes the administration heads of many of the state's natural resource agencies and is chaired by the governor or his representative. The present participating agencies on the TNRIS Task Force are the Texas Department of Water Resources, the General Land Office, the Texas Air Control Board, the Texas Forest Service, the Texas Industrial Commission, the Texas State Department of Health Resources, the Bureau of Economic Geology (University of Texas at Austin), the Railroad Commission of Texas, the Texas Department of Agriculture, the State Department of Highways and Public Transportation, the Texas Parks and Wildlife Department, the Texas Soil and Water Conservation Board, and the Texas Coastal and Marine Council.

political, statistical and other types of surface-collected data. Consequently, methods needed to be devised for integrating the collection and analysis of these various data types so that the resulting information and products represent the best combination of data from the available sources. As a result, the TNRIS Task Force and the National Aeronautics and Space Administration (NASA) have agreed to work jointly in an endeavor to provide these improvements for TNRIS agencies and to transfer the resulting technology to other interested users within and outside the state.

An important test under this joint project was to attempt a data-collection effort for a large coastal test site that involved the cooperation of several state agencies and NASA. The entire data-collection activity was tied to Landsat so that people, boats, low-altitude, medium-altitude and high-altitude aircraft had to be deployed to begin sampling near to the time of the satellite's pass. Only the medium and high altitude aircraft and three of the 15+ people were supplied by NASA. Interest was such that the potential for scheduling data-collection efforts with satellite overpasses may represent a significant option for states to maximize existing data collection efforts and made the data more relevant to a wider range of applications.

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